CLAIMS

What is claimed is:

1. A laser apparatus, comprising

a laser diode having a reflective back facet and a front facet having a reflectance of less than 1% for emitting an optical beam at a fundamental frequency along an optical path,

collimating means for at least partially collimating the optical beam into an at least partially collimated beam along the optical path,

a transmission grating optically coupled to receive the at least partially collimated beam and for returning a portion of the at least partially collimated beam back into the laser diode by means of diffraction through the collimating means and the laser diode front facet,

wherein the laser diode reflective back facet and the transmission grating form an extended laser cavity, and wherein in operation, at least a substantial portion of the at least partially collimated beam is transmitted through the transmission grating for producing the laser output beam propagating along the optical path.

2. The laser apparatus as defined in claim 1, further comprising means for rotating the transmission grating for tuning of the fundamental laser frequency.

3. The laser apparatus as defined in claim 1, wherein the extended cavity is an extended cavity in a Littrow configuration formed by the transmission grating.

4. The laser apparatus as defined in claim 3 further comprising a frequency-doubling nonlinear element positioned outside of the extended cavity to receive the laser output beam for producing a frequency-doubled optical output beam.

5. The laser apparatus as defined in claim 4, wherein the laser diode is a high-power laser diode for emitting light in a range of wavelengths between 350nm and 1600nm.

6. The laser apparatus defined in claim 5, wherein the frequency-doubling nonlinear element is for producing light output having wavelength in the range 175 nm – 800 nm.

7. The laser apparatus as defined in claim 1, wherein the efficiency of the transmission grating is selected to provide < 10% optical feedback into the laser diode.

8. The laser apparatus defined in claim 4, wherein the transmission grating is oriented so as to align the fundamental laser frequency within the spectral band for frequency doubling of the nonlinear element.

9. The laser apparatus defined in claim 4, wherein the nonlinear element is a periodically poled crystal.

10. The laser apparatus defined in claim 9, wherein the nonlinear element is a periodically poled $LiNbO_3$ crystal.

11. The laser apparatus defined in claim 4, wherein the nonlinear element is one of: a nonlinear waveguide, a single mode nonlinear waveguide, and a periodically poled nonlinear waveguide.

12. The laser apparatus defined in claim 4, further comprising optical means for passing the laser beam through the nonlinear element multiple times.

13. The laser apparatus defined in claim 1, wherein the transmission grating is a surface-relief diffraction grating.

14. The laser apparatus defined in claim 1, wherein the transmission grating is a holographic diffraction grating.

15. The laser apparatus defined in claim 1, wherein the transmission grating is made of optically transparent material with an anti-reflection coating on at least one side of the grating.

16. The laser apparatus as defined in claim 5 further comprising an optical isolator disposed between the transmission grating and the nonlinear element and optically aligned with said grating and said nonlinear element for preventing back reflections into the extended laser cavity.

17. The laser apparatus as defined in claim 5, wherein the nonlinear element and/or at least one of coupling means associated with the nonlinear element for optical coupling of the laser output beam and the frequency-doubled beam into and out of the nonlinear element are configured for preventing back reflections into the extended laser cavity.

18. The laser apparatus as defined in claim 1, further comprising a polarization controller disposed between the laser diode and the transmission grating and optically aligned with said grating and said laser diode for aligning a polarization direction of the optical beam with a polarization direction providing maximum diffraction of said beam by the transmission grating.

19. The laser apparatus as defined in claim 1, wherein the laser diode is oriented so to align a polarization direction of the optical beam with a polarization direction providing maximum diffraction of said beam by the transmission grating.

20. The laser apparatus as defined in claim 1, further comprising an anamorphic lens or an anamorphic combination of lenses disposed to receive light from the anti-reflection coated facet of the laser diode for reshaping the optical beam into a beam having substantially circular symmetry in a plain perpendicular to its optical axes for propagating along the optical path.

21. The laser apparatus as defined in claim 3, wherein the laser diode in operation has a substantially single-frequency optical spectrum.

22. The laser apparatus as defined in claim 3, wherein the laser diode, when in operation, has a substantially multi-frequency optical spectrum.

23. The laser apparatus as defined in claim 22, wherein in operation an electrical dither current is superimposed on an injection current of the laser diode for stabilizing of a time-averaged power of the frequency-doubled beam.

24. The laser apparatus as defined in claim 5, further comprising control means for controlling optical power of the frequency-doubled output beam at a substantially constant level.

25. The laser apparatus as defined in claim 23, wherein said control means are electrical and optical control means comprising:

an optical detector for measuring optical power of the frequency-doubled output beam;

a heating element for changing temperature of the nonlinear element; and,

an electrical feedback circuit electrically coupling the heating element with the optical detector.

26. The laser apparatus as defined in claim 23, wherein said control means are electrical and optical control means comprising an optical detector for measuring optical power of the frequency-doubled output beam;

means for rotating the transmission grating for tuning of the fundamental laser frequency; and,

an electrical feedback circuit electrically connecting the heating element with the means for rotating the transmission grating.